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IMPULSIVE X-RAY

by

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A dominant focus of our studies continues to be the response of the solar atmosphere to impulsive phase energization, notably by bombardment by beams of non-thermal electrons. The P.I.'s role on the Science Study Group for the High Energy Solar Imager (HESI) mission has led to the development of diagnostics (e.g., spectral, spatial, and temporal variations in hard X-ray flux) that can be tested by this mission, and which will be published in the upcoming Study Group report.

We have devoted a considerable effort toward understanding the temporal relationship between hard X-ray and soft X-ray emissions, in particular on the validity of the so-called "Neupert effect," in which the hard X-ray intensity is proportional to the time derivative of the soft X-ray flux. While it is tempting to explain this relationship by suggesting that the hard X-ray and soft X-ray emissions are proportional to the instantaneous power, and accumulated energy deposited, respectively, such an argument neglects several important factors, such as the various terms (conduction, radiation, mass motion) in the energy equation, and the fact that the soft X-ray intensity is proportional to the emission measure (and not the energy content) of the soft X-ray emitting plasma. We therefore (Li, Emslie, and Mariska 1993, *Ap. J.*, **417**, 313) carried out a series of detailed numerical simulations to investigate the extent to which the "Neupert effect" is evident in such simulations. We found that in fact the effect is indeed nicely reproduced in simulated bursts with duration ranging from 5 s to 120 s. The increase in soft X-ray intensity is primarily due to a temperature increase (in the plasma at or near the loop footpoint) during the first 15 s or so of each burst. At later times in the burst, an increase in the emission measure dominates the behavior of the soft X-ray emission. Since the behavior of temperature and emission measure is complicated by the onset of evaporation of the heated plasma, we next commenced an analysis of the temporal behavior of hard X-ray and soft X-ray emission at different spatial locations in the simulations. This work was also motivated by the recent YOHKOH observations of impulsive soft X-ray emission at loop footpoints (Dennis *et al.* 1994, in preparation). Preliminary results of this study were reported at the Baltimore AGU meeting (Li and Emslie 1994) and a journal paper is in preparation.

The P.I. participated in an innovative "mini-workshop", involving a handful of participants to address the narrow (yet physically challenging and relevant) problems of (i) the origin and structure of current systems in large systems such as solar flare loops and (ii) particle

acceleration in flares. These issues are both critical to the scientific objectives of the HESI mission. After a highly productive week, key issues were identified and in many cases resolved. A report/review of the workshop proceedings is in preparation, and will be submitted either to *The Astrophysical Journal* or to the *Journal of Geophysical Research*.